Technical change and employment growth in services: analytic and policy challenges

6. Technical change and employment growth in services: analytical and policy challenges

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INTRODUCTION

It is generally acknowledged that employment in our economies is increasingly dependent on services. As in other highly developed economies, the European countries are continuing their gradual move towards a service-based economy with today nearly 70 per cent of the total labour force being employed in service activities. It is also generally acknowledged that services provide the key to future employment growth. Neither agriculture nor manufacturing has been able to generate sufficient output growth to offset, in the last two decades, the productivity growth following the diffusion of labour-saving machinery and the reorganization of work and trades, impelled by increasing international competition. And while some high-tech manufacturing sectors have succeeded through the introduction of new and improved high-income-elastic consumer goods to generate new employment opportunities, their number has been falling steadily over time. Particularly in Europe, high-tech manufacturing sectors no longer witnessed any employment growth over the 1990s. Still, given the generally acknowledged importance of services for future output and employment growth, relatively little attention has been paid to technical change in services.

But technical change in services is a key issue to understand to what extent it will help to develop new markets and welfare or will be furthering the trends of automation. The future of work is at stake in these processes and the answers are not straightforward. Technical change in services has its specificities.

In the first place the development of goods and service markets is not submitted to the same type of constraints. The localization of services and the interaction between customers and producers that occurs in these trades impose specific constraints on the development of new products and of new processes. Both process and product innovations in services will thus be

more severely constrained by the willingness, abilities and original tastes and habits of the customers than they are for goods. Process innovations in manufacturing of goods are neutral for the product market and product innovations can be channelled by widespread advertising, marketing techniques or straightforward and rapidly diffusing demonstration effects.

Information and communication technologies (ICTs) have also a specific impact in that respect as these technologies transform the basic context in which services can be perceived and delivered. We say they change the tradeability of services and expand the potential of fields and forms of new markets. Conversely, ICTs transform the markets of goods, with more customerization and lasting relations, thus bringing characteristics of services to these markets.

These transformations clearly depend on the initial types of arrangements under which service markets are organized. These arrangements are very country-specific, implying local cultures and customs. They also depend on the skill structure of the country. Still one guesses that there is no determinism and that changes in regulations (which is more realistic than to speak of deregulations) and in policies may be quite important for the type and magnitude of new activities and therefore for the future of work.

This chapter does not attempt to answer all these broad issues. It aims to draw up some of the analytical arguments that we need to think in more appropriate terms about what is the dynamics of technical change in services, how it relates to the dynamics of employment in these activities and in which directions we should look for design policies at all levels.

We summarize in section 1 the traditional technology and employment debate and point to some of the contemporary challenges. The spread of service activities and the extent of internationalization of markets and production processes make it difficult to assess any 'compensation scheme', whereby the jobs destroyed in some trades by the emergence of new techniques and products would be more than offset by the gains in some other national trades. Opportunities for other countries or other activities to reap the benefits from the changes are too numerous. The second section traces the initial differences between innovations in goods and in services (generically speaking) and how ICTs, somehow, bridge some of these gaps.

Section 3 looks for the conditions under which service activities could presently act as an engine of growth for the whole economy. It goes on to stress the importance for the expansion of service markets and for employment of (a) user–producer relations, (b) the skill structure and (c) the time budget constraint.

The fourth section expands on the employment issue, taking into consideration, first, the high diversity of activities under consideration and, second, how the form of changes brought by ICTs depend upon skills and cultures.

The fifth, and concluding, section explores, on this basis, which kind of policies could be pursued to develop markets as well as the number and quality of jobs contributing to such development.

1. TECHNOLOGY, GROWTH AND EMPLOYMENT: THE END OF A VIRTUOUS CIRCLE?

The relationship between technology, growth and employment has traditionally been the subject of many contributions in economics.[2] While controversial, and the subject of intense debate over the last two centuries, the issue appears straightforward at least from the macroeconomic perspective. Either the introduction of new technologies leads to more efficient production processes, reducing costs by saving on labour, capital, materials, energy or any other factor of production, or it leads more directly to the development of new products that generate new demand. In either case, more welfare is created: in the first, through more efficient production combinations that liberate scarce input resources; in the second, by satisfying new wants.

The extent to which this higher welfare or increased productivity feeds back into employment growth depends on the extent to which firms translate productivity gains into lower prices and new investment and consumers respond to lower prices in terms of greater demand. The job losses that often follow the introduction of a new labour-saving process, for example, are compensated by the job creation associated with the output growth following the decline in prices, by additional employment creation in other sectors, particularly the new technology-supplying sector, and by the possible substitution of labour for capital following the downward wage adjustment that clears the labour market.

However, the extent to which new or improved products generate new employment growth depends on whether old products are replaced by new ones and on the responsiveness of consumers to the new or improved goods or services (reflected in the size of the income elasticity of demand). As long as there are unsatisfied needs in the economy and as long as labour and product markets are sufficiently flexible, technological change, even in the form of new labour-saving production processes, does not reduce aggregate employment but generates more growth and jobs.

Most of the controversies that have dominated the economics literature on this issue over the last decades have centred on the automatic nature of the various compensation effects described above. Many contributions have questioned the way in which cost reductions following the introduction of new technologies are effectively translated into lower prices and are likely to lead to more output growth: the functioning and flexibility of product markets

depend in part on the firm's monopoly power, the degree of economies of scale, and various other factors influencing 'price stickiness'. Similar issues can be raised with respect to employment growth and the functioning of labour markets; they range from downward wage flexibility to the many mismatches typical of relatively heterogeneous labour markets. In either case, it is less technology that is at the centre of the debate than the speed and clearing function of the product and labour markets.[3] The relevant policy issues fall primarily under the heading of improving the functioning of labour and/or product markets.[4]

Other contributions in the classical economics tradition have questioned the possibility of *ex post* substitutions between labour and other factors of production. At least in the short term, the implications of a more rigid fixed set of production coefficients for analysing technical change and employment are relatively straightforward. Labour-saving technological change embodied in new investment could, if wages adjust slowly, lead to unemployment because of insufficient investment to maintain the full-employment capital stock;[5] this is the so-called 'capital-shortage' unemployment.[6] There was a lively debate during the 1980s on the extent to which the increase in unemployment in European countries in the 1970s could be due to this phenomenon.

Yet other contributions question the automatic nature of the link between input-saving new technologies and productivity gains. Most of these studies (which often attempt to explain the 'productivity paradox') are empirical in focus and attempt to find reasonable explanations for the disappointing performance of productivity growth in most OECD countries over the last two decades, despite rapid growth in knowledge investment, in particular in private sector R&D, and the emergence of the new cluster of information and communication technologies. The OECD summarized much of this debate in the so-called 'Sundqvist Report' (OECD, 1986) and the subsequent 'Technology and the Economy' programme (OECD, 1992). However, the discussion is far from over. In particular, there have recently been a large number of empirical and theoretical contributions from growth economists (for example, Young, 1995; Mankiw, 1995).

Finally, some recent contributions have focused explicitly on the international 'open economy' framework within which most compensation mechanisms are likely to operate. As a result, the relatively straightforward linkages between technology, productivity growth and job creation mentioned above appear much more complex. A relatively simple elaboration in terms of employment compensation due to foreign demand, for example through export and import elasticities, complicates the matter greatly (Stoneman, 1984). More complete pictures including not only trade but also the effects of international spillovers of technology on productivity growth or international capital mobility make it much more difficult to identify the key

links between the introduction of a new technology and the ensuing domestic employment impact.

Many of the recent concerns about the implications of technological change for employment appear to relate to these international compensation mechanisms and to the way that gains from technological change are distributed internationally. In the gloomy vision of some popular authors,[7] 'wages in the most advanced economies are being eroded owing to the emergence of a global market-place where low-paid workers compete for the few jobs created by footloose global corporations' (Rifkin, 1995). Others (such as Freeman, 1995) stress that the wages of developed economies are not set in Beijing, because a lot of jobs are in trades which do not face so directly the competition of very low wages countries, because either the products are more sophisticated or differentiated and submitted to non-price competitiveness or the trades are local and sheltered from outside competition, as in some service activities. Thus, even when the internationalization of manufacturing and service industries is expanding, spurred by low costs of transport and communication, the balance of the interactions between technology and employment much depends on the type of competition prevailing on product markets and on service markets, which concentrate two-thirds of employment.

While it is still generally agreed that in a 'world' economy framework, input-saving technical change leads, through increases in productivity, to higher welfare, wages and growth, and thus generates new employment, the impact on individual countries is now much more complex and is based on a broad range of macroeconomic and microeconomic adjustment mechanisms. At the same time, the premium placed on the role of knowledge and on the acquisition of skills in this global environment implies that international differences in the pattern of employment and unemployment in industrialized economies may be coming to depend increasingly on the capacity of national economies to innovate, enter new 'service' areas and/or absorb new technology more rapidly.

2. NEW INFORMATION AND COMMUNICATION TECHNOLOGIES: BRIDGING TIME AND DISTANCE

The dramatically increased capacity to store, process and disseminate information at minimal cost has been described most extensively in the context of industrial (or agricultural) production processes. Predating even the early 'Information Technology' literature, the so-called 'automation debate', popular in the USA in the mid-1960s, described how labour-saving 'robotics' would raise industrial productivity and bring about major organizational

changes. In line with this literature, many IT analyses have always wondered how, confronted by such pervasive cost-reducing technologies, economies would be able to generate sufficient new employment (the various price and substitution elasticities being too low to bring about sufficient employment compensation[8]). More recently, the specific impact of new information technology on services has re-entered this debate. It could be argued that the impact on services will be more of an opposite nature compared to the impact on manufacturing.

In many ways services can be defined[9] as those activities (sectors) where *output is essentially consumed when produced.* While this might well be considered a rather narrow definition and one which covers only a limited number of sectors currently falling under the statistical definition of service sectors, it is an analytically useful definition because it highlights the intrinsic immaterial, intangible nature of many service activities, whether they are personal services, such as hair-cutting, entertainment, such as an opera performance, education, such as teaching, health, such as a doctor's visit, or public services, such as applying for welfare services. With intermediary services such as transport, communication, finance and trade, this simultaneity still holds, but is partially altered. Intermediary services are effectively delivered more or less on a permanent or fixed basis, whether they are used or not. The frequency of provision may vary, but in a scheduled way (timetables of services need to be available). The logistic support it gives is independant, in the short run, of demand. Good management should certainly adapt the level of production to the needs, while sizeable short-term productivity cycles remain a characteristic of these service industries. The link between production and consumption is somehow even more altered when considering such business services as marketing, R&D, consultancy, accounting and advertising.

It follows that services range from activities where production and consumption cannot be dissociated to all kinds of loose linkages between production and consumption. Still it is this similarity feature of production and consumption which has generally limited productivity improvements in such activities.

Information and communication technologies, almost by definition, allow for the increased tradeability of service activities, particularly those which have been most constrained by the geographical or time proximity of production and consumption. By releasing somehow these constraints, information technology will make possible the separation of production from consumption in a large number of such activities, thereby increasing the possible trade of such activities.[10]

On Tradeability

The notion of tradeability when applied to a commodity seems to refer to the propensity to be more or less readily accessible in time and space. The notion is vague and has been mainly used in international economics to distinguish between commodities which were traded internationally and others. Tradeability obviously depends in the first place on the context in terms of logistics organizing the market, such as the distribution system, the communication system or the transport system. We shall refer for this set of conditions to the standard means of market provisions. On top of that, the quality and characteristics of one product may be more or less easy to identify and require some specific knowledge or abilities.

Tradeability of any given product finally has two dimensions: how easy and costly its provision is and how clear and straightforward its use is. Provisionability clearly depends on transport and communications costs as well as on after-sale services. User friendliness depends on information, regulations, insurances and knowledge. This dichotomy somehow decomposes the 'transaction costs' which remain even on organized product markets.

An (incremental) innovation can enhance the tradeability of a product by improving either the context of provision or the straightforward content of a product.

Product and Process Cycles in Innovation Schemes

ICTs play an essential role in the transformation of information into knowledge as well as in the 'codification' of knowledge. The latter implies that knowledge is transformed into 'information' which can either be embodied in new material goods (machines or new consumer goods) or be easily transmitted through information infrastructures. It is a process of reduction and conversion which makes the embodiment or transmission, verification, storage and reproduction of knowledge especially easy.[11] In contrast with codified knowledge, tacit knowledge refers to knowledge which cannot be easily transferred because it has not been stated in an explicit form. One important kind of tacit knowledge is skills. The skilled person follows rules which are not all known as such by the person following them. They are linked to activities acquired through learning but often of a non-routine kind.[12] The most important impact of new ICTs is that they move the border between tacit and codified knowledge. They make it technically possible and economically attractive to codify kinds of knowledge which so far have remained in a tacit form.

The embodiment of codified knowledge in material goods has been typical of the dramatically increased performance of many new capital and consumer

goods, incorporating many new electronic information and communication devices. The latter in turn have been at the core of the continuous productivity, investment and consumer demand growth in Western societies. As emphasized by authors criticizing the early 'post-industrial society' literature,[13] this process could also be described as a process of 'industrialization' of services: the continuous replacement of particular service activities by household material goods, embodying at least the 'codified' knowledge part (washing machines, televisions, dryers and so on). The more recent electronic improvement in these products has further increased the 'household' performance of these products, freeing further household time. While the quality of these new material goods will not always substitute for the service activity they replace (a dishwasher is a good example), the codification process will be to some extent complete. The product might lack user friendliness (the typical example being the video player), but the user is not required to possess, or to understand, the knowledge embodied in the machine.

In services, by contrast, while the codification of knowledge will have made such knowledge more accessible than before to all sectors and agents in the economy linked to information networks or with the knowledge of how to access such networks, its immaterial nature will imply that the codification will never be complete. The codification process will rarely even reduce the relative importance of tacit knowledge in the form of skills, competencies and other elements of tacit knowledge – rather the contrary. These latter activities will become the main value of the service activity: the 'content'. While part of the latter might be based on pure tacitness, such as talent or creativity, the largest part will be greatly dependent on continuous new knowledge accumulation – learning – which will typically be based on the spiral movement whereby tacit knowledge is transformed into codified knowledge, followed by a movement back where new kinds of tacit knowledge are developed in close interaction with the new piece of codified knowledge. Such a spiral movement is at the very core of individual as well as organizational learning.

On Goods and Services

If we come back to the characterization we gave above on services, namely that they are produced and consumed *at the same time* and *on the same spot*, we see that it implies a low tradeability with respect to the two dimensions. In the first place, services cannot be stored, otherwise production and consumption could easily be separated. The market provision of services is therefore severely constrained. For the classics (and Smith in particular) this non-storability drastically limited the ability of service activities to take part in the accumulation process and therefore services were considered as not creating

value. Secondly, the fact that the service is consumed while produced leaves some uncertainty on its very content; the transactions are thus more open to asymmetries of information and hazards of different kinds.

On the whole this simultaneity of production and consumption clearly makes services less tradeable than goods. Still, the border between the two types of production is not so clear-cut. We mentioned in the first place that the simultaneity of production and consumption is more or less strict depending on which service we consider. Secondly, some goods such as some equipment goods, highly customized or produced upon specific order, have a low tradeability according to our definition. In that case a clear but specific content goes altogether most of the time with a more difficult type of provision (implying delays and special requirements for transport).

At a given time and space the set of products available thus displays a wide spectrum of tradeability indexes, where goods depending to some extent on their degree of 'standardization' have on average a higher rating than services. Moreover, these tradeability characteristics change over time. Even in the absence of any technological change and of any change in the logistics of service provision, simple learning processes would lead to some steady increases in tradeability. The crucial role of regulations in determining product tradeability should not be forgotten either.

Changes in the context of provision and in the content of products, which are produced by the diffusion of ICTs, can therefore radically modify the tradeability pattern of the products.

ICTs Can Alter this Simultaneity of Production and Consumption

Considering the new facilities brought by ICTs, services can be delivered in various places simultaneously with their production. The concept of production itself is spread over time when deliveries are automated (pushing a button in various automated tellers or similar). If services are also something you get in indefinite amounts, providing you show up at some counter (to get information, training and so on) the space simultaneity of production and consumption of services is also altered. The provisionability of services is thus greatly improved by releasing the constraint that services were consumed when and where produced. Besides, the problems raised in appraising the content of services may also be reduced, as ICTs can help to standardize and diffuse information on the products. On both dimensions, provision and content, the tradeability of services is thus improved, with a greater emphasis on provision improvement.

Conversely, ICTs seem to improve greatly the information and the control over the quality and the use of the goods we buy. This rise in the ability to certify the quality of goods and to control their use (the above content

dimension) is even more crucial than the improvement in the provisionability of goods, brought by intermediary services regenerated by ICTs (such as transport, distribution, finance and telecommunication).

Figure 6.1 illustrates simply these asymmetric improvements in the two components of tradeability for both industry and services. By and large, it suggests that the spectrums of tradeability of the sets of goods and of services are somehow converging. In effect, the tradeability conditions between goods and services are getting more similar through the effects of ICTs. This convergence results also from the fact that ICTs could well be characterized as reducing the time/storage dimension for goods and as bringing a time/storage dimension between production and consumption in services. Many of the most distinctive characteristics of the new information and communication technologies are effectively related directly to the potential of the new technology to link up networks of component and material suppliers, thus allowing for reductions in storage and production time costs – typified in the so-called 'Just-in-Time' production system. At the same time, the increased flexibility associated with the new technology allows for a closer integration of production with demand, thus reducing the firm's own storage and inventory costs, which could be typified as 'Just-in-Time' selling. Both features aim at reducing the *time/storage* dimension between production and consumption, but the 'tradeability' of products is not hampered because the product is more customerized (the buyer is made more confident that the product will meet his specific needs). In fact more customerized products, delivered just in time, transform the tradeability pattern of goods. Thus the paradox of opposed effects of ICTs on goods and services production disappears if one admits that ICTs eventually have an impact on two different things: the nature of the product itself and its provision. Figure 6.1 schematizes the relative convergence between the pattern of tradeability of goods and services.

Moreover, tradeability appears to be a notion highly dependent on the general context of provision (for the provisionability dimension) and of regulations and customs (for the conditions of use of the product). ICTs, in improving the logistics of intermediaries' activities which are organizing markets,[14] have shifted upwards the general level of tradeability. But, much like the notion of competitiveness, it is the relative level of tradeability which matters to the assessment of the new potential of product markets spurred by ICTs.

Finally, the fact that ICTs are making services more tradeable and more like manufactured goods on the one hand, and that ICTs favour the differentiation of products on the other, all lead to modifying the conditions of consumption.

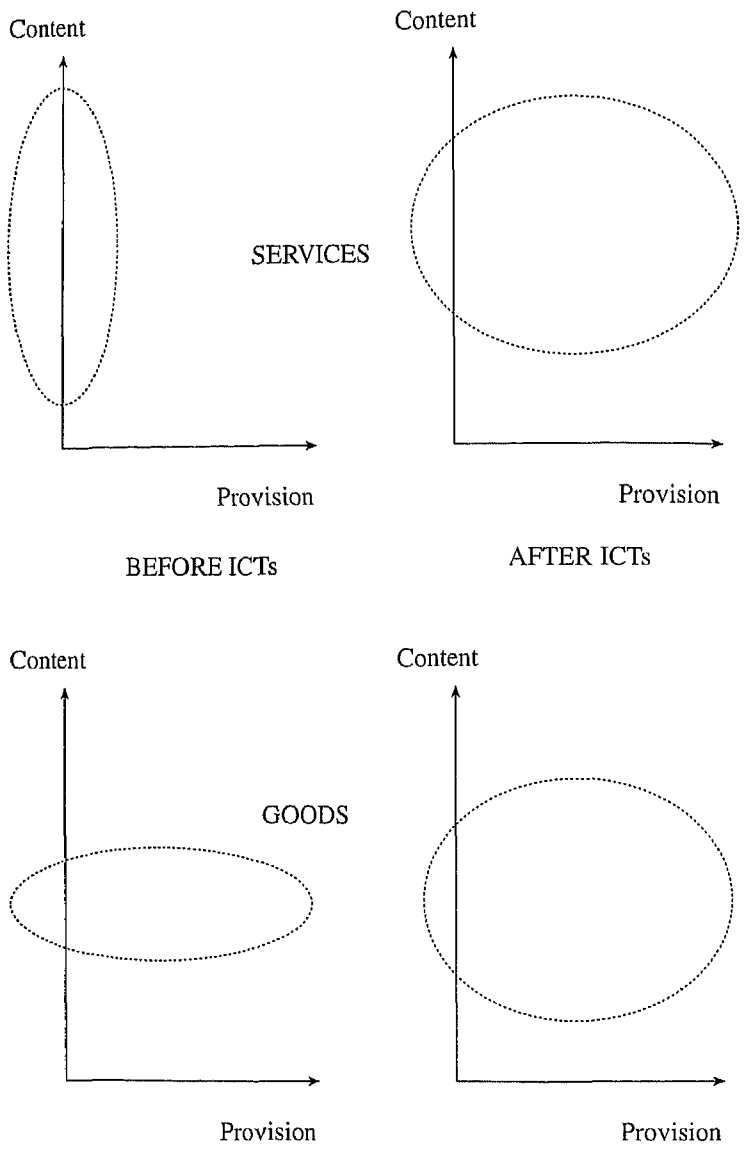


Figure 6.1 ICTs' effects on the tradeability of goods and services

A More Binding Time Constraint for the Consumers in a World of Enlarged Choices

We are used to thinking that new products lead to the discarding of old ones. Not only does innovation bring scrapping of old equipment and accelerate replacements but, according to the standard view, old varieties, often after a last fight (see, for example, Rosenberg's 'sailing ship effect') disappear. Historically, this stylized fact applies more accurately to innovation in goods than to innovation in services. In services, and especially in personal and social services as well as in intermediate services, it is quite characteristic that the new does not chase out the old to the extent that it does with goods. Services, modernized by some automatization process, are often seen as different services and the old form tends to become a service 'à l'ancienne' with an improved standard. Such has been the case with restaurants and hotels, but also with arts performances, distribution and personal care. Finally, innovation in services seemed to end up with a whole range of differentiated products.[15] A similar process happened with goods and 'antiques', but this remained a fairly marginal activity, while the decoupling of services by the modernization, partial or total, of their process of production contributes in the case of final services in distribution, catering and leisure activities) to enlarging the basket of activities at the consumer's disposal. Another way to look at this phenomenon is once again to note that, to the extent that in services production and consumption are tied, any process innovation is perceived by the consumer and therefore is also by nature a product innovation.

Insofar as manufacturing activities have gained similar service characteristics in using ICTs, while services themselves have become more tradeable, the basket of commodities available for the consumer has been greatly enlarged and transformed in nature, as their increased service dimension implies a more time-consuming consumption. As a result, more numerous and more time-consuming products have given de facto more importance than in the past to the time budget constraint, at least for the middle- and high-income groups. In effect, according to most recent surveys, while patterns of consumption have not been changing radically with the arrival of the new products, every choice seems increasingly to face competitive pressure from alternative time uses (Haddon and Silverstone, 1996).

To summarize our argument, we would claim that, for a long period of time, new industrial goods have been substitutes for old services (the industrialization of services hypothesis) therefore saving time for households which could be used to work and increase the capital stock of equipment. The relative convergence between some manufactured productions and services that is part of the diffusion of ICTs as we have underlined, leads us to insist

much more on the time constraint. Services take time and modernization both accelerates some brands of services (sometimes relying on self-servicing) and also expands their range. More sophisticated goods have to be serviced and, although they save time in most cases, they expand the range of choices in such ways that one feels more strongly the time budget constraint when facing these enlarged choices.

The time constraint is sometimes greater than the budget constraint. This was a typical pattern for rich people but it seems now to concern a much larger set of people. One might think of youngsters having an increasingly difficult time managing the time constraint between school education, home education, TV, multi-media entertainment, physical entertainment and contributions to housework.

Whether or not these changes contribute to giving a new role to services in the process of economic growth becomes a key question to address for the future of growth and employment channelled by the ICTs.

3. SERVICES: THE NEW ECONOMIC DRIVING FACTOR?

Since the emergence of ICTs and their impact on the tradeability of many service activities, which among other things partly blurred the frontier between goods and services, and since service activities correspond on average to two-thirds of economic activity in the EU countries, it is time to examine the role of these services in the process of economic growth.

Services as an Engine of Growth

Manufacturing has long been considered as an engine of growth for its capacity to organize and restructure production in ways allowing steady productivity gains. Economies of scale, such as replication on a larger scale of production processes, have been a favourite means to sustain this dynamics. It went together with the old Smithian principle that large markets allowed bigger scales of production, which in turn permitted a broader division of labour. Allyn Young (1928) emphasized the fact that such division occurred both within firms and between firms and that in all cases it stimulated technological change, which in turn fostered demand, so that economic growth propagated itself in cumulative ways. This was basically the mechanism referred to by Kaldor when speaking of manufacturing as an engine of growth.

Can one identify a similar cumulative dynamics in service activities? Certainly not in the pre-ICT period. Service activities were then seen in the

cumulative causation model as necessary conditions, complementary to the manufacturing engine of growth in order to organize markets (the provision of market access was a function of intermediary service activities). Meanwhile, personal services were looked upon basically in relation to the prevailing conditions on the labour market (see the sponge effect in the presentation by Kaldor of the determinants of employment in personal services).

The question is thus whether innovation, driven by ICTs, can launch a cumulative mechanism based on services somewhat similar to the one experienced in the past in manufacturing. Another way to rephrase this, following our previous definition, is to appreciate how innovation processes in services enhance their tradeability and help to expand their markets in ways which in turn cumulatively improve their efficiency and tradeability. The conditions for such a growth principle to be effective depend on the organizational issues raised by the diffusion of ICTs in services, in particular on the relation between processed information, knowledge accumulation and elaborated routines.

There is thus a need to compare the schemes of innovation in manufacturing and in services. The learning processes implied in cases of innovation in goods and in services are, as we argued above with respect to the different impacts of 'codification', rather different. They characterize to some extent the various patterns of cumulative growth that can occur. In the case of goods, the learning process is centred upon the product itself. Producers are learning how to adapt the new product to tastes and how to take advantage of expanding markets to make productivity gains which in turn will help to increase the market and improve the product. It corresponds to the first phase of a Vernon product cycle. Users have of course their say in the process but that say is by and large limited to a process of adjusting to the quality of the product. We would even go a step further: the main driving factor for innovation is performance or quality improvement, with the aim of convincing the average consumer that what he needs is the best, professional quality. In doing so the innovating firms can avoid, at least for some time, price competition. When the second phase of the maturing product is reached and standardization and imitation are taking place (for example, when competitors with low wage costs take over a stabilized production process), productivity growth is the only answer, but will depend heavily on the extent to which economies of scale can still be achieved. Conditions for sustained innovation and market expansion may thus depend on adequate demand policies.

By contrast, the similar dynamics in services tends to start from the opposite process innovation side, as suggested by Barras (1986). ICTs help to transform parts of the production process of services, mainly by codifying knowledge and processing accordingly information in one part of the old process.[16] The drive behind this substitution is in the first instance an increase

in the tradeability and market for an existing product. While it is not meant to modify the product, it will do so, in two stages. In our view though, and contrary to manufacturing, this will often imply in the first stage a product with lower-quality characteristics, compensated for by faster delivery. The driving force behind service innovation is thus not just process innovation; it is also cheap mass provision of a possibly lower-quality product. However, parallel to what was said above about manufacturing, the second stage will involve an explosion of new product innovation, involving high-quality, often personalized, services, using the new process technology for the specific aims and needs of particular users. It is through the combined effects of learning by doing and learning by using that the innovative content of the 'old' service product, produced with the new automated process, is progressively enlarged. Electronic networks have often evolved this way, as have a lot of new telecommunication products.

In other words, in this reverse product cycle, productivity gains are conditioned by improvement in the quality of the service products and process innovations alone are not sufficient (as they risk being associated with lower-quality products). This is a much more hazardous way to fuel a process of cumulative growth than is the case with manufacturing goods. It requires skill from the producers to enlarge the process into a meaningful product innovation but it requires also some learning from the consumer to direct and legitimize the quality improvement of the services. In this dual process of product innovation in services (mass products on one side, highly customerized services on the other) the challenges are different according to whether households or businesses are concerned. In particular, the markets of tailored new services are more difficult to develop with households as they require rather intense and long-term user–producer interfaces which only medium and large businesses usually enjoy.

Besides, the implications of this continuous shift in value from manufactured goods embodying increasing amounts of 'codifiable' knowledge towards service-based 'tacit' knowledge activities are typical of the new emerging Information Society. It explains the attempts of electronic and computing manufacturing firms to enter information content activities. Within services, it explains the move of 'carrier' operating firms, being most directly confronted with the codification of knowledge and its distribution, to enter content sectors (media, education, culture). This difference between innovation schemes in manufacturing and in services is much enhanced by the upstream dynamics of ICTs driven by the current miniaturization of microprocessors. It reinforces in all activities the process-driven dimension of technological change.

Figure 6.2 seeks to summarize these two schemes of innovation predominant, respectively, in goods and in services and to relate them to the specific

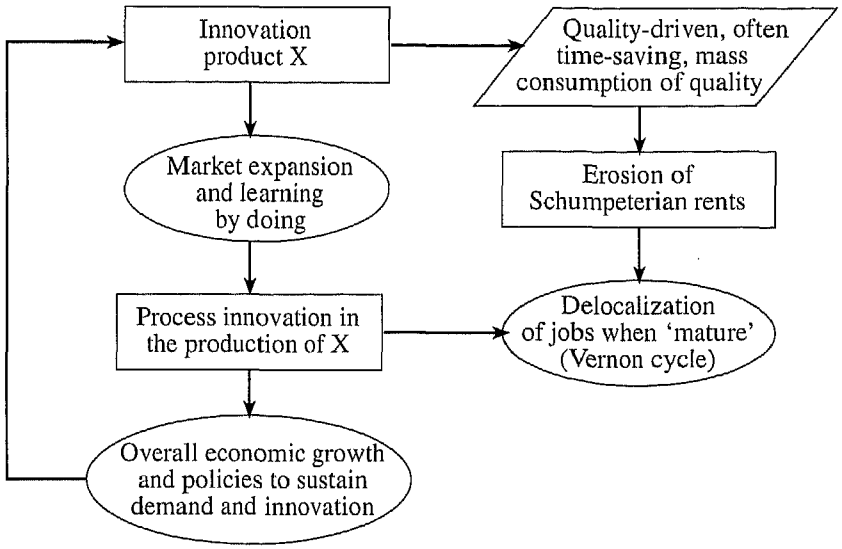


Figure 6.2(a) Innovation scheme in manufacturing

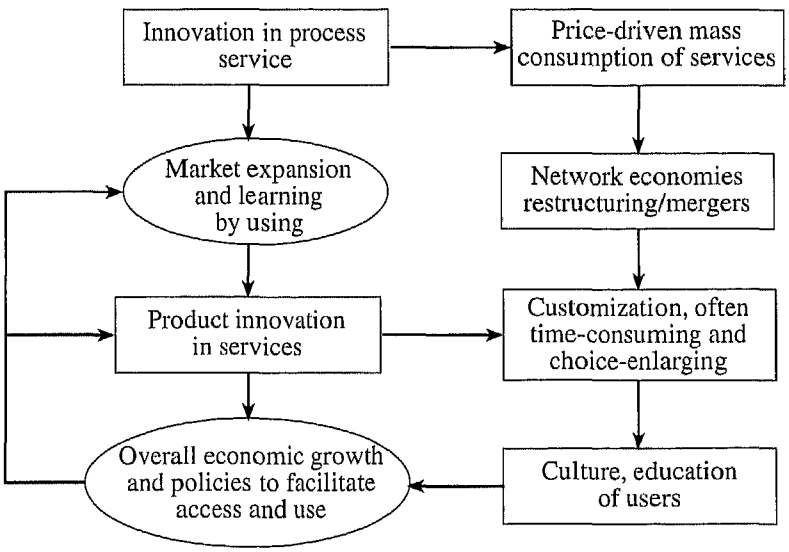


Figure 6.2(b) Innovation scheme in services

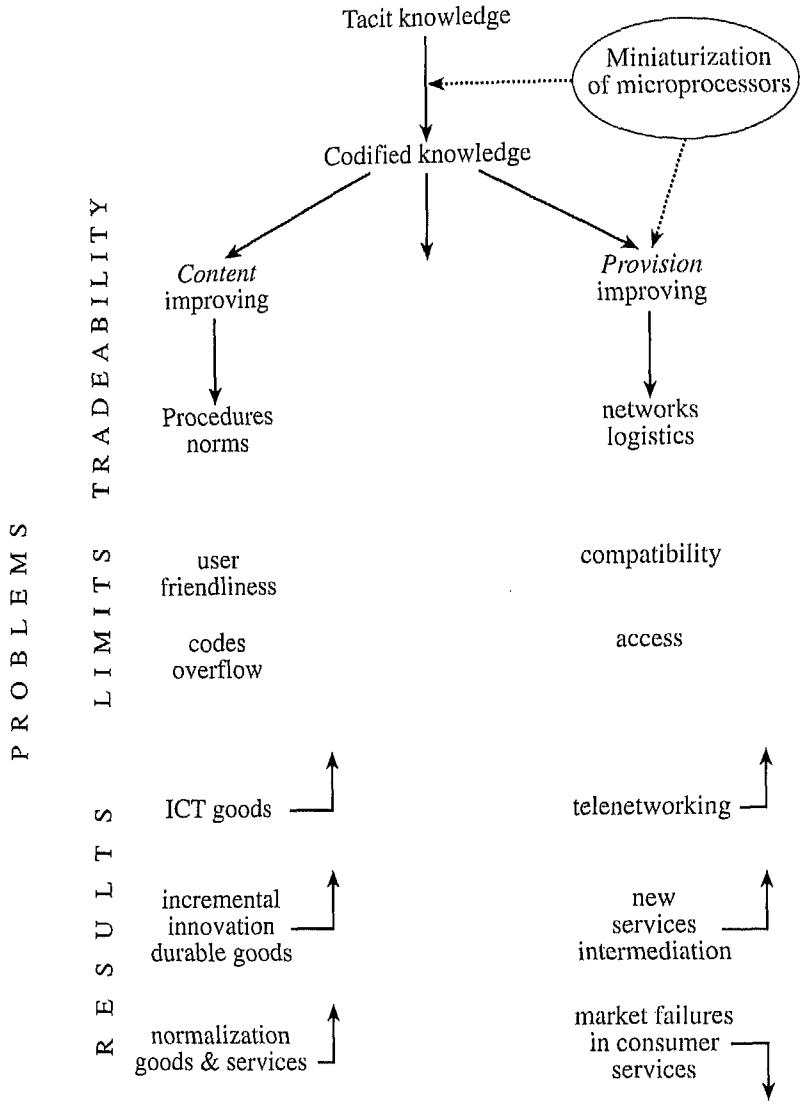


Figure 6.2(c) ICTs on tradeability

effect of ICTs. It stresses that the outcome of innovation processes depends more extensively on learning processes on the part of the users in the case of services than on the ready-made quality improvements of the suppliers in the case of manufacturing. It also brings to the forefront the need for a shift in

policies to sustain the innovation process. In the first case, policies to reflate demand, whereby the gains in productivity are reflected in gains in wages and domestic consumption, are essential to maintain the virtuous circle between productivity gains and new demand. The employment compensation mechanisms operate primarily through income-elastic demand for new and improved goods. The only changes brought by ICTs will be to shift the focus of innovation policy away from supply-dominated science and technology support policies to policies aimed at the translation of new scientific and technological breakthroughs into new innovations. Typically, most of the current EU innovation policies, as their name (VALUE) indicates, correspond to this aim.

In the second case, where the service-oriented innovation scheme prevails, policies will be much more diversified, helping users, in the first instance, to coordinate themselves, deregulating particular service markets and breaking up where necessary cartel agreements and providing incentives to new firms to develop services using the new provision channels of old services.

A Twin-motor Engine of Economic Growth

In fact both innovation schemes are obviously interrelated, in a world where manufacturing and service activities tend to be more and more connected. The debate over the 'engine of growth' has changed with the development of inter-firm relationships, and especially with the growth of business services. While intermediation services (such as transport, banking, distribution and communication) have always been steadily growing, along with the overall development of services, the key feature of the last phases of tertiarization (over the last two decades) has been the growth of business services (as shown in Table 6.1 and in the employment figures shown in section 4 below). This change is fully in line with the development of network and external relations that ICTs favour.

Therefore the growth dynamics clearly depends as much on the in-house know-how of the firms as on the facilities brought by logistics of business (and intermediation) services. This is the common thrust of all the arguments to be found in the highly diversified contributions to the literature on endogenous growth. It places the debate over the engine of growth sector in a new perspective, that our reference to a twin-engine of growth attempts to recall.

However, it is difficult to assess which are the main linkages and how they affect the overall economic dynamics. Complex links have already been mentioned, regarding both innovation schemes. Three of them are worth repeating. One has to do with the change in tradeability (regarded as an innovation) generated by changes either in provisionability or in the product content. The second is tied to the time-consuming or time-saving bias of

Table 6.1 *Tertiarization: the rise of business services in recent decades (service employment by sub-sector as a percentage of total employment)*

	Producer services	Distributive services	Personal services	Social services	Total services
France					
1960	3.5	16.8	7.9	16.0	44.1
1973	6.0	18.6	7.5	19.2	51.3
1987	9.0	20.1	7.9	26.4	63.4
Germany					
1960	3.4	17.5	7.4	10.3	38.6
1973	5.2	18.1	6.5	16.3	46.1
1987	7.7	18.1	8.1	21.6	55.5
Japan					
1960	3.3	18.5	7.5	8.2	37.5
1973	6.5	23.3	8.0	10.5	49.1
1987	10.2	25.1	10.2	13.0	58.5
Netherlands					
1960	4.2	20.4	8.5	14.7	47.8
1973	6.8	20.5	7.6	22.8	57.7
1987	10.8	21.3	8.6	28.4	69.1*
Sweden					
1960	3.5	19.4	8.4	16.3	47.6
1973	5.1	19.8	6.6	26.2	57.7
1987	7.2	19.2	5.9	35.1	67.4
United Kingdom					
1960	4.4	20.6	8.0	15.8	48.8
1973	6.5	20.1	7.9	20.8	55.3
1987	10.4	21.0	10.1	25.3	67.0
United States					
1960	6.4	22.2	11.3	21.2	61.1
1973	8.7	21.5	10.9	25.1	66.4
1987	10.4	21.3	10.1	25.3	67.0
Average					
1960	4.1	19.3	8.4	14.6	46.5
1973	6.5	20.3	7.8	20.2	54.8
1987	9.8	20.9	8.7	25.1	64.5

Notes: *Includes 2.1 per cent temporary workers employed at employment agencies who cannot be allocated to one of the four sub-sectors.

Source: Derived and updated from Appendix D in Elfring (1991).

contemporary innovation depending on the kind of product we consider. The third stems from the difference made in the learning processes at work in the different innovation schemes. We shall come back to these dimensions when looking at the dynamics of employment as in services. Effectively, as the way in which services are produced is part of their content, the criteria of employment (shares of qualified labour, of part-time or temporary jobs and so on) are also characteristics of the patterns of innovation. Meanwhile a two-sector growth model is given in the appendix to this chapter to specify the interplay between these three linkages and the macroeconomic dynamics.

4. STRUCTURE OF EMPLOYMENT AND CHANGES IN SERVICE ACTIVITIES

So far we have been mainly concerned with the dynamics of service markets and implicitly considered that employment could be fully determined by the levels of activity. The causality is not so one-sided, especially in the case of services.

Traditionally, in personal services the level and structure of employment have always been largely influenced by the conditions prevailing on the local labour market as the production in services can be more easily divided into tasks in accordance with local labour supplies. But this 'sponge effect' (as Kaldor named it) obviously acts on the quality and therefore the nature of the service products under consideration. Culture and traditions strongly conditioned how these personal service products were perceived by the users. The expansion of business services has been faced by similar challenges. One can effectively find, in this category of business services, highly-qualified jobs as well as poor jobs, which differentiate strongly between these activities.

In the present context of developed economies, largely engaged in tertiary activities and willing to take 'their' advantages of the new ICTs, the interdependence between the stock of human capital, in broad multidimensional terms, and the growth path has been reinforced. The issue is at the core of recent works on endogenous economic growth (see Lucas and Romer's various contributions over the past decade). However, the issue is not as linear as is often assumed in the sense that 'more human capital' is not always positively correlated with more economic growth. Clearly, some matchings are required between the education of workers, the forms of on-the-job training, the availability of efficient producer and intermediary services, along with the capabilities of users. We want hereafter to explore some dimensions of this complex nexus, directly linked with the use of ICTs in service activities.

The assessment, made in the previous section, of what would be the main characteristics of a growth process more centred on service activities leads us

to stress the new role bestowed on users in the learning processes. On one side the choices of products and activities for all users (final or intermediate) have been enlarged and consist of more time-consuming products. Therefore choices between alternatives within the time budget constraint are more compelling and lead the consumers/producers, through some new learning processes, to modify slowly their way of life. On the other side, the dynamics of innovation, which starts most often from process innovations directly driven by the diffusion of regularly improved ICTs, relies more largely for its expansion on positive feedbacks from potential users. The development of these learning effects modifies the content and the provision of new services. A networking effect with positive externalities sustains the diffusion of radically new services.

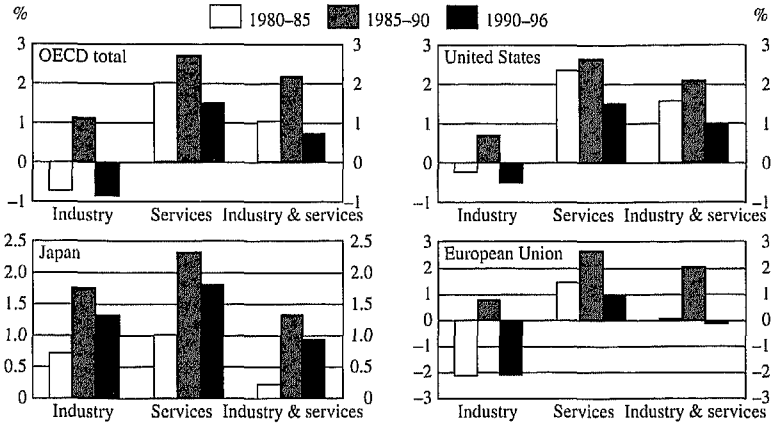
However, we know little of these learning processes. The productivity slowdown, much more marked in services than in manufacturing activities (see Roach, 1991), suggests that organizational mismatches and market failures may be more important in service activities than elsewhere. Moreover, not all service activities are in the same position, if only because, as we noted, their tradeability differs. In all cases the above implies that the dynamics of cumulative growth may depend to a larger extent than previously experienced on the quality of the labour force. We shall consequently look hereafter at employment in services with two considerations in mind: that the growth potential may specifically depend on the quality and size of the labour force and that situations may differ widely from one service activity to the other.

In presenting statistical trends, use will be made of the official statistical classification of service industries and the classification of services in four one-digit ISIC (International Standard Industrial Classification) sectors: wholesale and retail trade, hotels and restaurants; transport, storage and communications; finance, insurance, real estate and business services (FIRB); and community, social and personal services (CSPS).

Trends in Service Industries Employment

The crucial importance of services for overall employment growth in the EU, but also in the USA, is illustrated in Figure 6.3, representing employment trends for the period 1980–96 for the EU, the USA, Japan and OECD total for services, manufacturing and total employment. Even in Japan, services employment has now become essential for overall employment growth, manufacturing employment having fallen substantially since the early 1990s.

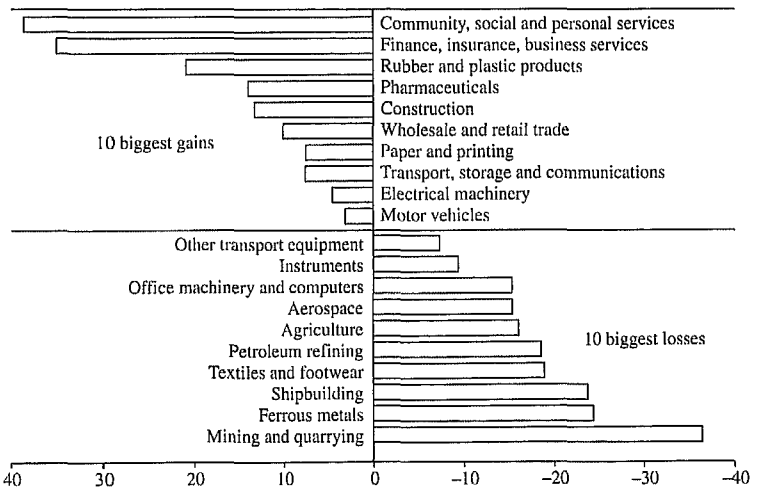
As Figure 6.4 illustrates, amongst the sectors with the most substantial employment growth in the EU for the period 1970–93, service sectors (real estate and business services; social services; restaurants and hotels; and fi-



Note: Industry covers mining, manufacturing, utilities and construction; services covers all services, including government.

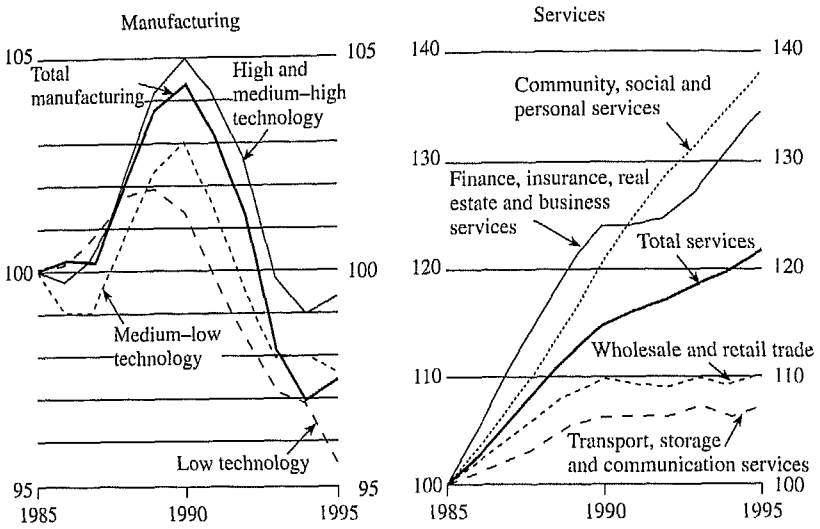
Source: OECD, *Labour Force Statistics*, December 1997.

Figure 6.3 Employment growth in industry and services (compound annual growth rates)



Source: OECD, STAN and ISDB databases, December 1997.

Figure 6.4 Job gains and losses, by industry, OECD total (percentage change from 1985 to 1995)



Source: OECD calculations from STAN and ISDB databases, December 1997.

Figure 6.5 OECD employment trends in manufacturing and services industries (1985 = 100)

nance and insurance in the first four places) dominate with only a couple of high-tech manufacturing sectors (computers, pharmaceuticals, communications, aerospace) witnessing above average employment growth. This pattern is more or less similar for the USA.

Figure 6.5 represents the trends in employment for four broad service sectors: financing, insurance, real estate and business services (FIRB, ISIC 8); community, social and personal services (CSPS, ISIC 9); wholesale and retail trade, restaurants and hotels (ISIC 6); and transport, storage and communications (ISIC 7); as well as manufacturing (ISIC 3) for the OECD countries. Interestingly, the FIRB and CSPS service sectors witnessed the most rapid employment growth.

These two service sectors, FIRB and CSPS, illustrate well the totally different impact of ICTs on employment. In the case of FIRB, ICTs have led over this period to a substantial increase in the tradeability of such services; in the case of CSPS, ICTs have had practically no impact on tradeability, most of these services depending crucially on physical contact and presence in delivering such services (even if ICTs are more and more put to use in the 'back office' of these CSPS services, they do not change their content). Basically, the magnitude of these services depends on the relations between the domestic and the formal economy (public and pri-

Table 6.2 Employment ratios by NACE sectors (percentage of population between 15 and 64 years of age)

	BEL	DNK	GER	GRC	SP	FRA	IRL	ITA	LUX	NLD	AUS	PORT	FIN	SWE	UK	EU 15
Trade	8.3	10.2	8.9	9.2	7.9	8.2	7.8	8.9	8.6	10.4	11.1	10.1	7.1	8.6	10.8	9.1
Hotels	1.8	2.0	2.0	3.4	2.8	2.0	3.1	2.2	2.7	1.9	3.7	3.2	2.0	1.8	3.1	2.4
Transport and telecom	4.3	5.3	3.4	3.7	2.8	3.8	2.6	2.8	4.0	3.9	4.6	2.7	4.4	4.7	4.3	3.6
Finance	2.4	2.4	2.3	1.4	1.3	1.9	2.2	1.7	5.9	2.1	2.4	1.9	1.4	1.3	3.0	2.1
Business services	3.6	5.4	4.0	2.3	2.8	5.1	3.6	2.7	3.6	6.3	4.5	3.1	5.2	4.7	6.6	4.3
Administration	5.4	4.7	5.5	4.0	3.1	5.7	3.2	3.8	6.4	4.8	4.6	4.5	3.0	3.6	4.2	4.6
Education	5.1	5.7	3.3	3.3	2.8	4.5	4.0	3.8	3.4	4.1	4.0	4.5	4.5	5.2	5.4	4.1
Health	6.0	12.7	5.8	2.5	2.6	6.2	4.7	2.9	4.3	8.6	5.3	2.0	8.6	14.1	7.5	5.6
Other services	2.1	3.8	3.2	1.9	1.7	2.5	3.1	2.1	1.9	2.4	2.9	2.9	3.2	5.8	3.6	2.7
Domestic services	0.1	0.2	0.2	0.6	1.4	1.3	0.0	0.5	0.6	0.2	0.3	1.4	0.1	0.0	0.4	0.6
International organizations	0.3	0.0	0.1	0.0	0.0	0.1	0.0	0.0	2.8	0.0	0.1	1.0	0.2	0.0	0.1	0.1
Total services	39.4	52.6	38.7	32.3	29.8	41.4	34.5	31.4	44.3	44.9	43.5	37.3	39.6	49.8	49.0	39.1
Agriculture and industry	17.2	22.9	23.9	24.6	18.0	18.9	21.8	20.0	15.3	20.3	26.3	28.7	22.0	20.5	20.7	21.2
Total employment	56.6	75.5	62.6	56.9	47.2	60.3	56.3	51.4	59.6	65.1	69.8	66.0	61.7	70.3	69.8	60.3

vate), all of which are very country-specific, as can be shown simply through the wide range of employment ratios to be met in the European countries (see Table 6.2).

It is also worth noticing that the productivity gains have on average been really low in these two kinds of activities. We have here a noticeable manifestation of a productivity paradox, considering that investments in ICTs have been relatively important. By contrast, intermediate services, where investments in ICTs have been especially important, displayed relatively enhanced productivity gains, as expected, but with little expansion of markets and therefore little employment growth.

Looking precisely at industries by country could bring more insight into this question, but data on real growth are problematic, on two grounds. In the first place, activities are not organized in a similar way and sectors may not correspond from one country to the other; secondly, there is a severe measurement problem in most cases where, precisely, ICTs seem largely to have transformed the content and provision of activities. The quality improvement of those services may well have been underassessed in the national accounts.

Over the last decade, the mismeasurement of consumer surplus may have become quite sizeable (see Nakamura, 1995; Boskin, 1996; Moulton, 1996). Such mismatch though is not a simple statistical flaw. It points to an important 'under appreciation' of the quality improvement of some products. Careful studies, using hedonic price indexes, could tell how much of this 'evaporation' of the consumer surplus can be blamed on statistical methods and how much is due to some 'deficit' on the part of users. This issue is rather important for the dynamics of the CSPS sector in times of ICTs and for its employment potential: all the more so now that the CSPS sector represents more than one-third of total employment in the EU and the USA, substantially more than the whole of manufacturing.

A similar issue of mismeasurement of real term values is raised for the FIRB sector, where such measures have always been problematic. The question is all the more important in that technological change not only modifies the content of these services but also strongly blurs the frontiers between activities.

Firstly, services, partly as a result of the increased tradeability of service activities in financial, communication and other business services, and partly as the result of the increased 'outsourcing' of intermediate inputs, have in other words become much more dependent on cyclical swings, causing similar upturns and downturns in service activities. As an increasing number of such service activities are becoming deregulated or opened up to international competition, these sectors are likely to become much more vulnerable to economic contractions and their traditional role as sheltered sectors of employment reservoir is becoming significantly reduced.

Secondly, major structural changes develop as a response to the challenge of internationalization and technological change. These include the following:

- potentially major shifts between sectors and services (for example, as retail banks restructure away from physical branches and offer a wide range of services electronically while expanding from finance into other sectors, such as travel, entertainment and shopping);
- new alliances and industrial groupings between different sectors (for example, between media and communications, leisure and education, finance and computing);
- accentuation of the trend to globalize and deliver services internationally;
- increasingly close links between suppliers and providers, supported by electronic data information and vastly more accessible and improved inter-enterprise networking and connectivity;
- greater opportunities for small and medium enterprises (SMEs) through universal access;
- greater openness and participation of customers, consumers and businesses.

With such restructuring of service activities, straightforward extrapolations of past trends are of little help. Insights on the development paths to be followed have to come from analytical arguments.

Global Competition and Changes in Work and Occupations in Service Industries

The structural changes mentioned above are accompanied by considerable changes in the way people work and are employed in service industries. Let us start with the essence of the new global competition which concerns some of these services.

As a consequence of the increased potential for international codification and transferability, the new information and communication technologies can to some extent be considered as the first truly 'global' technology. The possibility of ICTs codifying information and knowledge over both distance and time brings about more global access. Knowledge, including economic knowledge, becomes available worldwide. While the local capacities to use or even have access to such knowledge will vary widely, the potential is there. ICTs, in other words, bring to the forefront the enormous potential for catching up, based upon the transparency of economic advantages, while stressing at the same time the crucial importance of tacit knowledge to access international codified knowledge. For technologically leading countries or firms, this im-

plies increasing erosion of monopoly rents associated with innovation and shortening of product life cycles.

At the same time, the ability to codify relevant knowledge in creative ways acquires more and more strategic value and will affect competitiveness at all levels. Network access as well as the competence to sort out the relevant information and to use it for economic purposes become of critical importance for performance and income distribution. Specific skills relevant to the use of information become of strategic importance. More routine skills, by contrast, might become largely codifiable and their importance dramatically reduced.

For services this might imply significant relocalization possibilities for many routine functions. The increased potential for teleworking does not stop at the border. The rapid growth in teleservices in less favoured regions, such as Ireland, is illustrative of this potential for relocalization of hitherto untradeable service functions. In essence, this is a process of international division of labour whereby service sectors are discovering advantages of international relocation. The impact of the decline in communication costs following the widespread use of global ICTs on the international trade of services can be compared with the impact of the decline over the last 30 years in transport costs on the international trade of commodities and manufactured goods. This threat does not mean that a huge proportion of service activities will be delocalized, if only because delocalized activities which deal with codified information can in turn be fully computerized, while activities 'back home' can develop in expanding their capital of tacit knowledge.

Still the increased competition and market orientation that are the consequence of the above changes affect, to a greater or lesser degree, the work organization in all activities. By and large, such increased tradeability of services implies substantial shifts in the occupational and skill structure of service industries employment. The following broad trends can be expected:

- less security of employment and of careers in traditional areas (such as front and back office clerical work in banks, post offices and so on);
- a much more explicit need for staff to be responsive to customers, able to adapt to and offer new services;
- an increased ability to adjust to internal changes in company structure, such as reduction of the traditional hierarchy;
- a need for quickly acquiring new skills – particularly for more worldwide communication;
- the need for public sector workers to adapt to the market rigours typical of private enterprises;
- lifelong learning or readiness for a continuous acquisition of skills and knowledge;

- expansion of opportunities in services where human interaction remains the essential element: teaching, health, entertainment, leisure, social services.

These changes will represent a considerable change in the nature and content of work as well as in the organization of the workplace. Making the best of these trends in terms of growth and employment, when their outcomes seem far-ranging from the worst to the best, has become a major challenge, all the more so since countries are starting from rather different positions regarding occupational structures. Services industries have typically been characterized by their extensive use of white-collar workers and the current growth of employment in services has reinforced this characteristic. In both the manufacturing and service sectors the number of blue-collar workers employed is decreasing.

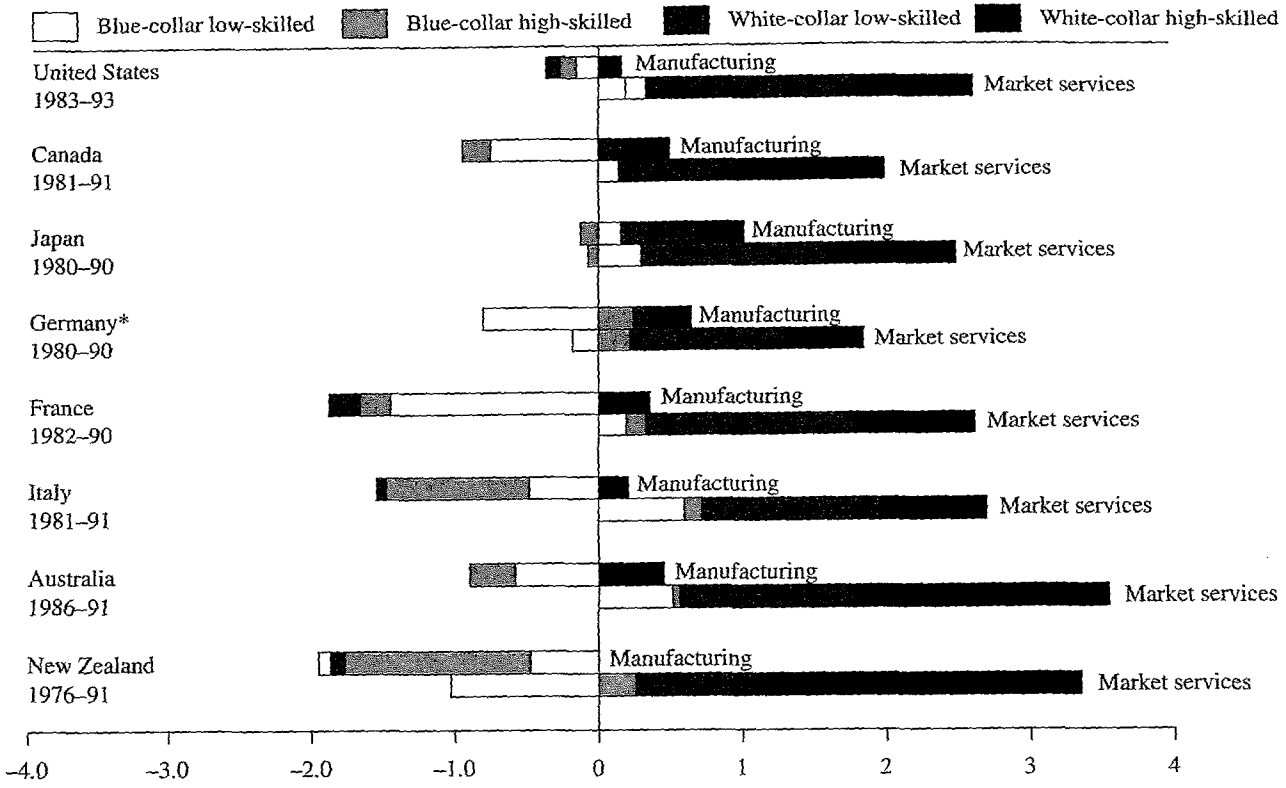
Still large differences appear in the occupational composition by sector across countries when looking at the skill level of the new jobs created (see Figure 6.6). The distribution of the changes in employment by occupation between 'professional and technical workers', the most highly-skilled occupational category, and the relatively low-skill categories, such as 'sales workers', 'clerical and related workers' and 'service workers' seems important and somehow displays the differences in national trajectories. The question then is whether these changes in occupational skills are improving or worsening the position of the various countries.

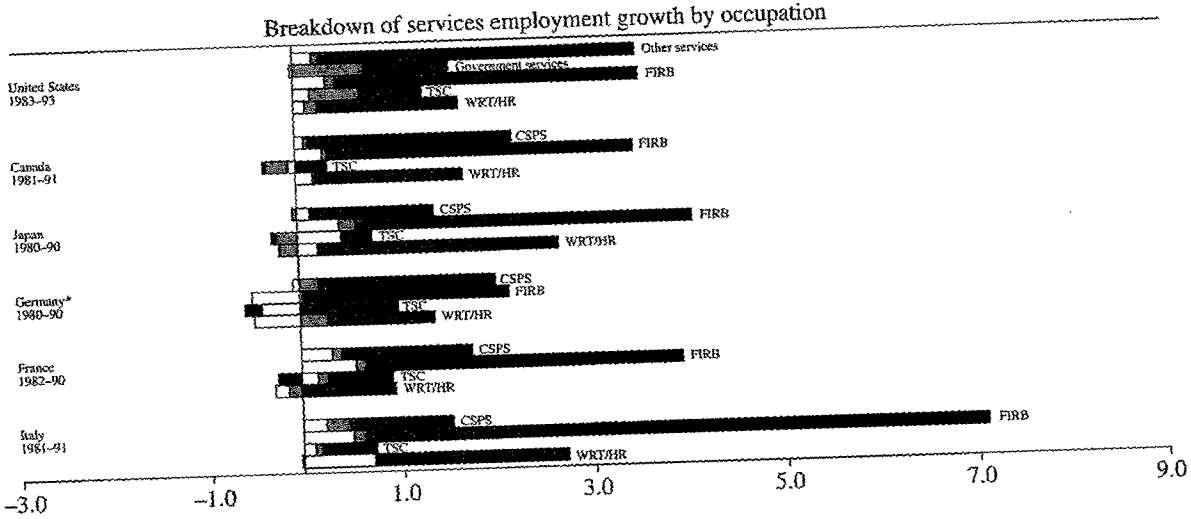
Interdependence of Technological Change, Skill and Culture

The ability to codify knowledge in creative ways, mentioned above as a factor of competitiveness in a world where service activities are internationalizing, seems to imply that technological change will lead to upgrading the average skill level in the activities concerned. Therefore one would find in services that the technological change that ICTs represent is skill bias, as has been suggested concerning manufacturing industries (see Berman *et al.*, 1994). However, the argument might run somewhat differently when considering the whole range of services.

If we follow the argument presented when schematizing innovation in services (see Figure 6.2b), technological change in services is to be assumed to depend on both the skill structure of the producers of the services and on the 'skill structure' or cultural background of the consumers of these services. The assumption of such 'reverse causality' stems directly from the reverse product cycle that we identified as an important pattern of innovation in service activities.

To clarify how this interaction between consumers' capabilities and products innovation functions, it is useful to distinguish service industries according


Blue-collar low-skilled
Blue-collar high-skilled
White-collar low-skilled
White-collar high-skilled
United States
1983–93
Manufacturing
Market services
Canada
1981–91
Manufacturing
Market services
Japan
1980–90
Manufacturing
Market services
Germany*
1980–90
Manufacturing
Market services
France
1982–90
Manufacturing
Market services
Italy
1981–91
Manufacturing
Market services
Australia
1986–91
Manufacturing
Market services
New Zealand
1976–91
Manufacturing
Market services
–4.0
–3.0
–2.0
–1.0
0
1
2
3
4



Notes:
See text for definitions: growth rate are annual average growth rates.
*The white-collar high-skilled group in Germany excludes some occupations and is thus underestimated.
Abbreviations: WRT/HR, 'Wholesale and retail trade, hotels and restaurants' (ISIC 6); TSC, 'Transport, storage and communications' (ISIC 7); FIRB, 'Finance, insurance, real estate and business services' (ISIC 8); CSPS, 'Community, social and personal services' (ISIC 9).

Source: OCED Secretariat calculations from national data, STI/EAS Division.

Figure 6.6 Employment growth, by skill level, in manufacturing and services

to the extent to which the reverse cycle hypothesis applies. Basically, this innovation scheme fits rather well the case of industries with a large number of registered customers, engaged in recurrent transactions, as in banks and insurance, but also in large systems of distribution, transport and communication. These intermediary activities are organized in networks addressing diversified communities of customers. The need to cut down the running costs of these networks is the main drive for process innovations. How these process innovations may lead to product innovations is at the core of the thesis of the reverse product cycle. The question is thus to see how changes in the way services are delivered on these networks create conditions for product innovations to emerge from active user–producer interactions.

The answer lies at two levels. At the first level some intermediary activities may attract sub-sets of customers, but the exact forms of new services suitable for consumers and provisionable by services producers have to be elaborated in a joint learning process. The number of services that can be extensively developed straightforwardly without this cross-learning process is limited.[17] Producers have to engage in processes of trial and error through which they may develop specific services for segments of their customers. Customers' reactions help to define the content of the products. Basically, this clustering of new products much depends on the cultural and educational backgrounds of the groups of consumers concerned, whether they are final users or small and medium enterprises. We have then a process of product differentiation which can lead to product innovations according to the creativeness of the interplay between the two learning processes involved. Price differentiation to adjust to the various needs and possibilities of the customers is a common practice of the intermediary services. Product differentiation is more difficult to achieve and requires adaptive flexibility which large systems of intermediation may have lost.

The second level of answer precisely takes this rigidity into account in stressing that often SMEs of services take part in this process of innovation, either by taking over developments from large networked industries or by selecting directly such niches in making use of the improvement of the intermediary services. We then have an extended version of the reverse product cycle where firms innovate to fulfil specific needs using the technological innovations made in the production process of intermediary services.

At both levels (of the intermediary services or of their users) the potential for product innovation depends on the abilities of the users and on the quality of the feedback they give. It conditions the extent to which the codification of information in the new services can leave room for the development of personal involvement and accumulation of new tacit knowledge. Conversely, if one aims to develop products in accordance with the capabilities and likings of the consumers, the qualifications required of the labour force

delivering the service may also mix various skills. In particular, semi-skilled workers might be more productive intermediaries because they are closer to the consumers than high-skilled or low-skilled attendants.

All of which suggests that successful learning processes (able to expand markets) could require more balanced (more realistic in a way) approaches to the skill requirements in a lot of service trades.

5. POLICIES AND PERSPECTIVES

We have so far only assessed some of the key dimensions and questions raised by a growth pattern where service activities are preponderant and technological change is intensively fuelled by the steady diffusion of ICTs. The bases for new virtuous circles are still unclear and highly conditional. Even if we have stressed a convergence between manufacturing and service activities, it does not follow that the forms of industrial organization have converged towards some best-practice form of organization. Services have always been very country-specific owing to the set of institutional arrangements that their market provision requires; the fact that ICTs have transformed their content and their 'provisionability', which partially shows in the fact that they are more sensitive to the business cycle, does not radically alter this feature. National institutional contexts matter. Regionalization processes, as experienced in Europe, or the liberalization of trade and foreign investments, have also contributed to some convergence among the production processes; however, we are far from having industrial fabrics in service activities which can be easily compared internationally. This implies that, if any new growth model is emerging, there is a strong likelihood that these models will differ between countries. We have not reached that stage where the identification of growth patterns can take into account national differences, even if the overall coherence of such patterns may differ markedly from one case to the other.

The fact that the cultural backgrounds of consumers were important conditions featuring the growth path of national economies is also an important reason to affirm that the 'new' growth model will be plural.

Even if our knowledge and assessment of these new schemes remain patchy, because changes are still going on and may well extend over long periods of time, we should be able to conclude with some policy orientations as well as indicating some crucial lines of research.

We can finally list three policy orientations regarding, respectively, investment and related industrial policies, labour market policies and, finally education and training policies.

We have stressed in this chapter all the organizational difficulties raised by the market provision of services, using the facilities of ICTs. Asymmetries of

information and externalities remain numerous in these activities in these new networks and hinder some of the growth potential of this new fabric. Therefore public interventions to coordinate actions, certificate intangible productions and internalize positive externalities are very worthwhile. These public investments can take many forms, still this public intervention is hindered by trends towards deregulation, precisely in the intermediate services such as banking, telecommunications and transport where appropriate industrial policies should help to develop the logistics and normative framework required to coordinate the actions of private agents and internalize their effects. While the deregulations have been largely provoked by the obsolescence of the old regulatory frameworks, often inherited from the 1930s and 1940s, they have been too often viewed as a necessary withdrawal of public intervention. Though new regulatory frameworks need to be elaborated (and ICTs need to open new possibilities in that respect) in order to take full benefits of the current structural changes, this can be done all the more easily when it is accompanied by appropriate infrastructure investments, which can be tangible (especially in telecommunications networks, for instance) or intangible (in the form of specialized training schemes, broader intermediation institutions or social networks to facilitate the access of the populace with various cultural levels to new services). A wide range of measures can be envisaged at the European, national and (mainly) regional level that we can group under the heading of new industrial policies. The current problem is the total lack of commitment to such policies, given the absolute priority given to monetary rigour and fiscal consolidation.

A second set of policy issues concerns the labour market. Large amounts of public money are devoted, at least in European countries, to coping with the rise and persistence of unemployment. These measures are costly and their efficiency is questioned; their main flaw is that they are subject to important deadweight loss effects (meaning that most measures have little net incentive effect but possibly big distorting price effects, largely uncontrolled). Keeping in mind the change towards a growth regime where services and time budgets play a different role may help to reconstruct these labour market policies in ways which provide the safety net (guaranteed income), while inserting people who are out of work in any of the training schemes that are part of some learning processes, either on the consumer side (networks accessing any of the big social systems) or on the production side (networks retraining the labour force according to needs and wants) or both. Such a comprehensive approach to labour market policies should therefore be developed in setting up any scheme to reduce working time, where what the people out of work will do is as important as where and how the reduction will be implemented.

The third and last set of policies is familiar as it concerns education and training policies. The fact that it should concern, not so much initial forma-

tion, but lifelong training schemes is also widely accepted. How it can be implemented or which principles are implied is less straightforward. Our analysis suggests that we should look at the various types of learning required not only at all stages of a working life, but at all stages of consumer life. This includes also looking at the rate of obsolescence of knowledge, on one side, and at the cultural backgrounds and their evolution over time, on the other. Returns to illiteracy and rigidity of cultural patterns regarding the use of ICTs are also important features revealing the difficulties of maintaining certain levels of training. For example, people engaged in jobs requiring lower qualification than they obtained, is another source of deskilling. However, such deskilling at work could be compensated for by 'reskilling' in consumption or other non-work activities. Policies have to be realistic and take into account the poor performance of some groups and the barriers to access of some ICT uses. If training policies only aim at some general improvement they may well strengthen a tendency to discriminate that one finds at work (with skill-biased modernization) and at home (with cultural barriers to access to some service provisions).

Finally, it is also worthwhile to recall some of the lines for future research suggested in our analysis. A first question concerns the dynamics of codification. How can we consider that codified knowledge is accumulating, what is its economic rate of depreciation, which includes 'physical obsolescence' and being overtaken by competition? These questions are crucial to clarifying how codification of knowledge leaves room for increases in tacit knowledge and efficiency. There are also questions on the rate of return to innovations. Too fast depreciation with a lack of similar speedy organizational change will reduce too rapidly or strongly the returns from innovation of the intangible investments under consideration (social as well as private benefits of innovation in a world where network externalities are omnipresent may also be concerned).

A second line of research, following from the above, has to do with our approach to educational and cultural issues. How far are skills specific or general; how do they combine during life cycles? Are training periods specific out-of-work periods or can they be mixed with on-the-job or in consumption learning? In which case, could training be dealt with in the organization of work? How does this apply respectively to large, small and medium firms? Conversely, what is the nature of the cultural barriers to access? By which practices could they be overcome or adapted? Does this training need to be channelled by formal social networking? Could it be conveyed by adapted forms of products and uses? We know relatively little on how ways of living and consumption patterns react to differentiated ranges of new products and services.

A third line of research would go back towards the identification of what would be the growth model in a fully developed 'information economy'. Of

special interest would be the way such economies evolve in a context of growing internationalization. A large proportion of service activities take part in that process of internationalization. Does this lead to specific forms of competitiveness, or do these service organizations evolve towards some best-practice universal pattern of provision? By contrast, it would be interesting to see how country-specific the organization of social and personal services can remain. These issues are directly linked to research trying to characterize the nature of the globalization and the extent of the convergence of production processes and consumption patterns that internationalization brings in a world market with a rapid diffusion of steadily improving ICTs.

NOTES

1. This chapter is a revised and extended version of a paper presented by the authors at the conference on 'Technology, Employment and Labour Markets' held in Athens University of Economics and Business, 16–18 May 1996, published as a 1997 working paper by the Enrico Mattei Fondation, Milan.
2. There is now a voluminous empirical and theoretical literature on this subject (see the surveys by Freeman and Soete, 1987; Petit, 1995). In the 20th century alone, we may distinguish four sets of economic debate on the relationship between technology and employment. The first, probably the most 'classical' in its origins, took place during the economic depression of the 1930s. Contributors included Hansen (1931, 1932), Kaldor (1933), Weintraub (1937) and Neisser (1942). Many of the issues and concerns raised by these authors sound quite familiar today, particularly in the context of the notion of increasing returns in current 'new' growth models (for example, Aghion and Howitt, 1991). The second debate focused mainly on postwar United States and the fear of 'automation'. In the 1960s, levels of unemployment were higher in the United States than in Europe, and many blamed technological change. As a result, a National Commission on Automation was appointed and produced a massive six-volume report (US National Commission, 1966). This debate had little influence in Japan and in the European countries that were rapidly catching up. The third debate, which began in the late 1970s, was particularly active in Europe. It focused on the emergence of the cluster of computer-based communication, information and automation techniques associated with microelectronics, which appeared at first glance to have great labour-displacing implications (for example, Freeman *et al.*, 1982; OECD/ICCP, 1984; Katsoulacos, 1984). The fear that these displacement effects might dominate the compensating job creation effects for quite some time recalled in many ways the classical debate. As there, it appeared to be a reflection of the times: there was a set of 'revolutionary' new technologies and persisting high unemployment. The most recent debate focuses much more on the global aspects of the new information and communication technologies and the possible erosion of employment and high living standards in the advanced countries. Originating to some extent in the United States, and linked to the political debate surrounding NAFTA, it quickly spread all over the world.
3. As von Mises (1936, p. 485) put it: 'Lack of wages would be a better term than lack of employment, for what the unemployed person misses is not work but the remuneration of work. The point [is] not that the "unemployed" [cannot] find work, but that they [are] not willing to work at the wages they [can] get in the labour market for the particular work they [are] able and willing to perform'.
4. Both the OECD *Jobs Study* (1994a,1994b) and McKinsey Global Institute (1994) can be said to have focused primarily on these market issues. The former emphasized the func-

tioning of labour markets, the latter the functioning of product markets, particularly in services.

5. This result is obtained by Venables (1985), for instance, with the use of general equilibrium setting with fixed coefficients.
6. 'Capital shortage' unemployment reflects a seeming lack of 'productive' capital to employ part of an 'adequately' skilled and suitably located labour force. Capital shortage unemployment can occur as a result of both lack of physical capacity and economic obsolescence; if variable costs exceed price, capital will not be used (and the corresponding jobs will disappear) even though such capacity could be operated in a physical sense (OECD, 1984).
7. See, for example, Aranowitz and DiFazio (1994) and Rifkin (1995), In many ways, and as noted by some trade economists (Krugman and Venables, 1994), such views are to some extent reminiscent of the old Prebisch–Singer *dependencia* arguments, but applied to the advanced countries. In the old core–periphery models, 'immiserising' growth in the developing countries would take place because all the benefits of increased efficiency gains in raw materials, agricultural and labour-intensive manufacturing production were passed on to the advanced economies, fo example through lower prices or higher repatriated profits. In the current view, the pattern is the opposite: most of the benefits of technological change are passed on to some of the rapidly industrializing countries through more rapid international diffusion of technology from the advanced countries, the reinvestment of profits and relocation of production to those industrializing countries, and the erosion of various monopoly rents in the advanced countries, including wages. In principle, though, and in contrast to the Prebisch–Singer model, such a redistribution process should lead, as trade theory would predict, to the convergence of growth and income.
8. Interestingly, this is still the main argument of those studies in this area which limit their focus to manufacturing (Pianta, 1996; Reati, 1995; see also comments from the Commission on the OECD G7 study).
9. For early analyses along these lines, see Quinn (1986) and Soete (1987).
10. This was certainly the case with regard to the invention of printing in the Middle Ages and the impact this first new information technology had on the limited tradeable 'service' activity of monks copying manuscripts by hand. It was the *time/storage* dimension of the new printing technology which opened up access to information in the most dramatic and pervasive way and led, to use Marx's words, to the 'renaissance of science', the growth of universities, education, libraries, the spreading of culture and so on. This opening-up, 'tradeability' effect would become of far more importance to the future growth and development of Western society than the emergence of a new, in this case purely manufacture-based, printing industry.
11. See in particular David and Foray (1995) and Ergas (1994).
12. One might think of such activities as gardening, cycling or housekeeping.
13. See, amongst others, Gershuny and Miles (1983).
14. Though the transformation of intermediary services is not homothetic and therefore the effects on the organization of markets and production are biased in favour of some means of intermediation. Thus transport costs may have fallen systematically over the postwar period, but they have risen significantly in relation to communication costs over the last decade.
15. With, at the extreme, the self-service where innovation is turned into new goods for personal use. (TV sets and cars can be seen in such perspectives as following on from long lines of innovation in entertainment and transport industries.)
16. This modernization of the production process can be done by direct use of ICTs in the process or indirectly by using modernized intermediary services (banks, transport, communications), as we shall stress in section 4. Such extension gives a much wider scope to the thesis of the reverse product cycle that we have referred to.
17. Banks and distribution services experienced some difficulty in the early 1980s in entering the market of tourist services straight away.

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INTERNATIONAL DIFFUSION OF TECHNOLOGY KNOWLEDGE

Comment: Luc Soete

David Audretsch's paper provides a broad, highly personalised overview of a large body of literature brought together under the "international technology diffusion title" and encompassing such diversified fields and topics as diffusion theory, technological paradigms, national systems of innovation, European competitiveness and Germany's *Standortkrise*.

In a typical Audretsch style, the overview presented is selective, provocative, nicely written and full of anecdotal detail. After criticizing the diffusion literature for focussing too much on the diffusion of particular technological rather than organisational innovations, the author briefly describes most of the traditional early diffusion literature. I fully sympathize with the author's difficulty in having to summarize this vast literature in a couple of pages. However, the overview could have gained by focusing on some of the more recent diffusion literature. As it stands the overview is really incomplete, both in terms of reviewing the most important contributors and in providing a full overview of the many directions in which progress has been made over the last thirty years. Thus, the omission of Paul David in this overview is not just striking, it has also resulted in an underemphasis of some of the recent contributions in this area focusing amongst others on the relationship between various diffusion models (semilogistic, probit, etc.), market structure, profitability and learning.

More substantially though this traditional view of diffusion has led the author to stick to a rather linear product life cycle view of the innovation process, starting with basic research and ending up somewhere with a new commercial product or process. Most researchers working in the innovation and diffusion area today would probably strongly disagree with this view. And I guess that even Audretsch himself is probably more inclined to see his ideas about technological trajectories and paradigms fit much better the more systemic approach to the innovation and diffusion process. Let me highlight briefly, why the latter approach is much more appropriate.

First of all, there is of course the view that throughout the diffusion process, there is a continuous feedback with research, with basic science, and besides that the diffusion process is one of continuous incremental improvements to the particular initial product. In other words, there is a learning process taking place. That learning process can more and more resemble an accumulation process of a whole set of codified and tacit pieces of knowledge which are converging and therefore create new forms of tacit knowledge.

Secondly, there is a crucial relationship between "producers" of the new technology and users. During the diffusion process the crucial feedback from the users of the new technology, of the new product or new production process is essential in the further improvements to that product or to the process. Again I'm sure that Audretsch knows this literature, such as the studies of Lundvall et al. on the Danish diary industry, whereby diary machine producers interacted systematically with diary producers to continuously improve their products. There are lots of similar studies done at the sectoral level, e.g. at SPRU (Keith Pavitt built his by now famous taxonomy precisely on such studies) illustrating this continuous interaction between users and producers. This literature explains actually very well some of the locational features emphasized by Audretsch -- the sectoral clustering; the sort of "systemic" view of diffusion behind this process; the crucial importance of incremental, accumulated improvements along the diffusion process; etc. -- all features characteristic of a much more Schumpeterian view of diffusion.

My other criticism is that the use of individual cases, more correctly: cases of "individuals", needs to be substantiated to a much larger extent. There are of course many interesting cases useful in terms of the description of the details of what happened, but there are also all the unknown stories of where firms pursue correctly new innovation areas. Much more empirical work is needed before one can draw conclusions from such "individuals" case studies. I refer amongst others to a recent NBER paper on the location of new biotechnology firms and the particular role played by "star" scientists in the creation of such new high tech firms. So while individuals do matter, there is a strong need for more systematic empirical research in this area, going beyond the simple anecdotal description of "individuals" cases.

Another major criticism on Audretsch's paper is the particular by vague description of the notion of "paradigm shift". Some of the people participating in this conference have also used this concept but with a very different meaning. Frieder Meyer-Krahmer in a recent paper refers to a "paradigm shift" in terms of the nature of technologies shifting to become much more science based, much more complex, multidisciplinary, etc. I know e.g. that Sylvia Ostry uses the concept of paradigm shift in terms of the shift towards a service economy, information society. So I think it is essential for Audretsch to elaborate and be much more specific about this concept.

Let me conclude with two comments, elaborations one may say on Audretsch's paper.

First, I would strongly argue that one of the underlying processes of a possible paradigm shift towards global networking of information, is closely related to the tremendous increase in the codification of knowledge due to information and

communication technology. The latter has increased enormously the possibilities to have worldwide access to codified knowledge and thus appears at least at first sight to have reduced the amount of tacit information. One may think of the concept as explained by Richard Nelson or Giovanni Dosi: "you cannot be a good cook by just reading a cook book". Well, if one looks at the increase in terms of audio and visual information and the continuous additional ways in which more information is being codified, my conviction is that one certainly can increase one's performance as a cook. You might never become a Bocuse but you certainly will -- without actually having spent too much time in practicing and learning -- through the increase of that part of codified knowledge giving you e.g. visual information on the sort and quantity of all the ingredients, what sort of "impact" the mixing of such ingredients may have, illustrating how other people do it, improve your "cooking" ability. Of course, the value of the remaining amount of tacit knowledge will relatively speaking increase and become even more important. But I still would argue that it is the incredible increase in the amount of information which can be processed, codified and internationally traded and exchanged which is the essential feature behind the present paradigm "shift".

Let me then as final comment, raise some more speculative questions, inspired by Audretsch's paper, looking more at the European side than the German side of the issue. First, on the basis of the indicators we have calculated for the European Commission (the so-called European Science and Technology Indicators Report), the evidence is that if you want to talk about crisis, there is possibly a real crisis in Japan. In Japan the R&D indicators, the patenting indicators for the first time but many other economic indicators, too, show a significant decline particularly in the high tech areas and the technology-intensive sectors. Whether this is a cyclical or structural phenomenon is too early to answer. Secondly, if you look at the indicators of countries in the EU or Germany, there is indeed convergence of indicators in terms of scientific publications, patent publications or R&D efforts pointing to remaining strengths in particular but closely related sectors. Thus, there is a traditional weakness in Europe, and in Germany in particular, in the information and communications sectors. Let me though emphasize that what is missing in this sort of indicators analysis is precisley the link between the micro diffusion part and the macro or sectoral evidence.

This is where I think one could either go in the direction which Rivera-Batiz gave us in his presentation which is: argue that the R&D decline in Europe in some sectors is closely related to shifts, trade-offs between sectoral shifts in terms of human capital, e.g. in the information and communication technology sectors. Maybe this has been enforced by technology policies which have focused too much on traditional ways in which to strengthen the R&D basis and not on the particular features which had more to do with

the shift towards the information service sectors and the importance of new emerging activities. One could also go the other way which is more in an institutional direction. Do we have the appropriate institutions in Europe or are they sufficiently prone to assist in this sort of shift. Let me just refer to a paper I am writing with Richard Nelson in which we start from the argument that new growth theory gives us empirically a major research paradox. That is to say that regarding the research part where one would assume that "ideas", that research would lead to the highest externalities or the largest effects in terms of increases in growth, i.e. the basic or fundamental research part, there appears e.g. in a cross-country setting a negative rather than positive relationship to actual growth performance. This apparent research paradox does not only question the empirical support for "pure" new growth theory, it also questions the traditional premises of government policy in the area, supporting generally speaking precisely that part of research which seems to be the most basic, the most fundamentally related to new ideas. This paradox highlights precisely the crucial part institutions have to play in increasing the efficiency of the science and technology system. Whether this leads to arguments about the need for international corporate governance or to criticism of particular German institutions which might have failed to make the necessary shift, is then the policy challenge to which Audretsch's paper has certainly given much food for thought.